

Equipping Tomorrow's Military Force:
**Integration of Commercial and Military
Manufacturing in 2010 and Beyond**

**National Research Council
Board on Manufacturing and Engineering
Design**



*DoD PEO/SYSCOM Commanders
Conference
Fort Belvoir, VA
November 2002*

THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine

Michael F. McGrath, Committee
Chair
703-310-1210
mmcgrath@sarnoff.com

Background

- **Sponsor's task statement (JDMTP)**
 - Assess opportunities for increased integration of commercial and military manufacturing in 2010 and beyond
 - **1990s Civil Military Integration (CMI) studies**
 - The issue was economics
 - **Today**
 - The issues are fast response, technological superiority
- This NRC study takes the viewpoint that access to commercial lines that are “up and running” is a military necessity for 2010 and beyond**

The question is “How?”

Committee Members

Broad experience in ICMM issues

- **Michael F. McGrath, Chair, Sarnoff Corporation**
- **Walter B. LaBerge, Vice Chair, Naval Postgraduate School**
- **Arden L. Bement, Jr., Purdue University**
- **RADM Peter DeMayo (USN, ret.), Lockheed Martin Corp. (ret.)**
- **Gary L. Denman, GRC International (ret.)**
- **Joseph A. Heim, Genie Industries**
- **F. Suzanne Jenniches, Northrop Grumman Corp.**
- **James Mattice, Universal Technology Corp.**
- **David R. Smith, Eastman Kodak, Company**
- **Robert I. Winner, R. Winner & Associates**

NRC Staff: Patrick J. Doyle and Toni Maréchaux, BMAED Director

Sponsor Liaison: Leo Plonsky, Navy ManTech

Integration of Commercial & Military Manufacturing

More than just COTS . . .

ICMM Opportunity Space

					Component
					Subsystem
					System
	COTS	Dual Use Manufacturing			Defense Unique
Product	Commercial	Enhanced Commercial	Unique Commercial	Unique Commercial	Unique
Manufacturing Process	Commercial	Enhanced Commercial	Unique Commercial	Enhanced Commercial	Unique

*Neither end
motivated to reach
into the middle*

Why ICMM and Why Now?

A compelling military need

- **Unpredictable threat**
 - Cannot equip for all contingencies
 - Commercial base: flexibility, rapid response and replenishment
 - **Technological superiority**
 - Commercial sector often has the lead; more so by 2010
 - Need to exploit faster and better than adversaries
 - Spiral upgrades and life cycle support
 - **Opportunities growing**
 - If barriers are removed
- ICMM will also save money . . .***

Briefings to the Committee

Rich source of lessons learned

Mr. Brench Boden, *Air Force ManTech*

Mr. Jim Fallon and Mr. Joe Thomas, *M/A-COM*

Dr. Jacques Gansler, *University of Maryland*

Mr. Larry Griffin, *R. Winner Associates*

LTG Paul Kern, *U.S. Army*

Mr. Steve Linder, *Navy ManTech*

Dr. Fenner Milton, *Army NVESD*

Dr. Spiros Pallas, *OUSD(AT&L)*

Lt. Col. Walter Price, *DARPA/AFMC*

Mr. Herm Reininga, *Rockwell Collins*

Mr. Stan Soloway, *DUSD (Acquisition Reform)*

Mr. Robert Spreng, *Integrated Dual Use Commercial Companies*

Mr. Larry Trowel, *General Electric Aircraft Engines*

Mr. Steve Werner and Mr. Jerry Thomas, *SCI Systems*

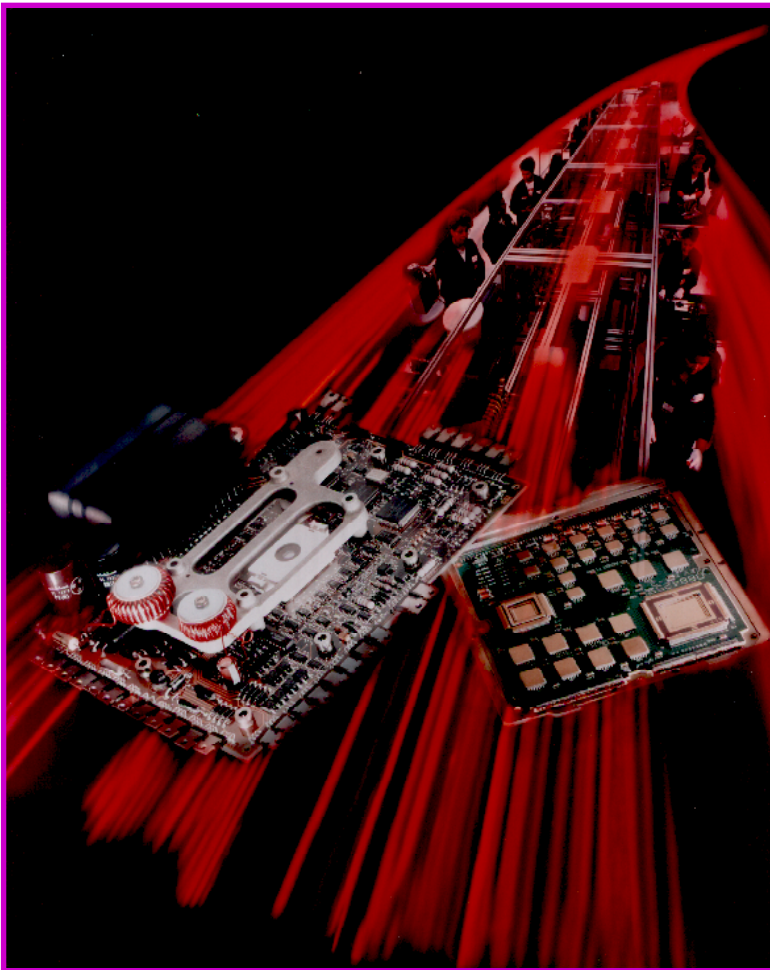
Examples

With a strong champion, ICMM can be done

<u>Project</u>	<u>Results</u>
AF Mantech/TRW Military Parts from Comm'l Lines	Technical and acquisition feasibility for F-22, RAH-66 electronic modules, 90% reduction in time to production, 30- 50% cost savings
M/A-COM & Northrop Grumman ALQ-135	Commercial design and production of RF modules for EW system. Long term contract with 50% price reduction curve
Rockwell Collins ARC- 210, PLGR GPS, and others	Commercial redesign, long term support contracts, single process initiatives, dual production throughout company
DARPA/AF Miniature Air Launched Decoy (MALD)	Pushed envelope -- high performance military unique system from commercial sources

Military Products from Commercial Lines

AF ManTech/TRW Project



MISSION

- Demonstrate the commercial manufacture of military electronics modules and measure and migrate

AFFORDABILITY DEMONSTRATION

- Military module manufacture on high quality commercial line.
- Use of commercial plastic parts and supplier systems to reduce cost.
- Contracting practices to access commercial suppliers.
- Flexible computer integrated manufacturing
- IPD and IPT techniques.

RESULTS

- 30-50% cost savings for F-22 and RAH-66 electronic modules.
- Tools and practices for implementation across DoD, industrial base.

Example 2

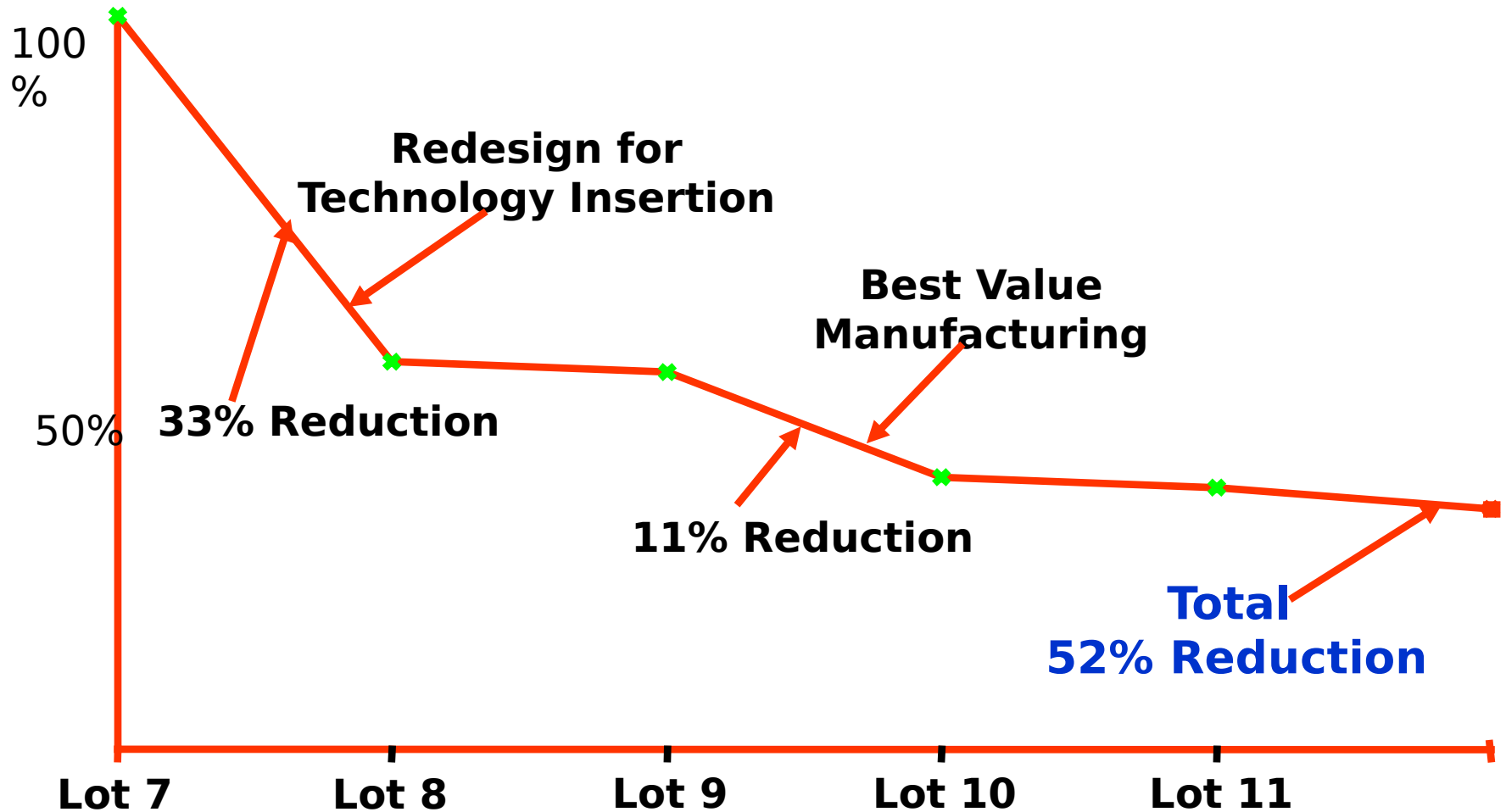
ICMM at Rockwell Collins

A dual-use manufacturer

<u>Project</u>	<u>Action</u>	<u>Result</u>
Single Process Initiatives	Evaluation of all military and civilian processes.	Operating costs reduced \$30 million in first year; another \$30 million anticipated for second year
Army Precision Lightweight GPS Receiver (PLGR)	Single process; commercial parts; commercial process; maintenance and availability are contractor's responsibility	Direct labor content = 3 to 4% (rivals best commercial high-volume) Eliminated parts obsolescence problem
Navy ARC-210 radio	Redesign for commercial parts and processes; annual design reviews; maintenance and availability responsibility at contractor	Price reduced 42% Field reliability (MTBF) increased from 500 flight hours to 807 (+62%)

M/A-COM Northrop Grumman ALQ-135

Commercially produced EW subsystem

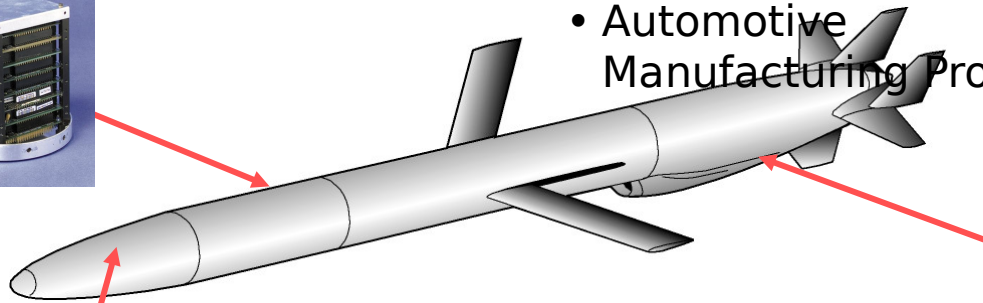
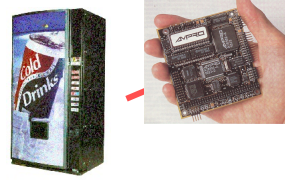
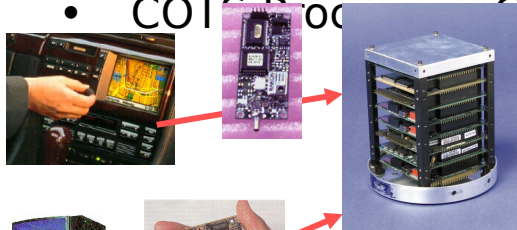


DARPA Miniature Air Launched Decoy (MALD) ACTD

Pushing the ICMM envelope – \$30K flyaway cost

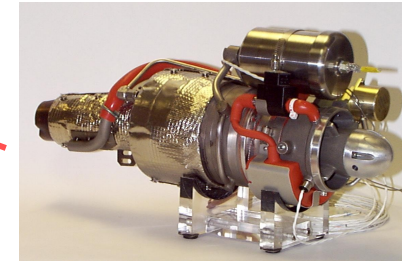
AVIONICS

- Commercial Open Architecture
- COTS Processor, GPS, IMU



AIRFRAME

- Composite Wing, Empennage, and Fuselage
- Automotive Manufacturing Process



PAYLOAD

- Low Cost Components, Automated Production



Commercial Resistors, Capacitors, Inductors 75% Cost Reduction Compared To MIL Standard

PROPULSION

- Low Parts Count Design
 - 20 Assembled Parts
 - Cast Vs Machined Parts
 - 1.2 Labor Hours
- Non-Traditional Aerospace Vendors

Findings

1. Defense system integrators have pivotal role in ICMM
2. Recent successes in ICMM show it can be done beneficially at the subsystem level
3. Commercial trends make ICMM increasingly desirable in 2010 and beyond
4. Long standing barriers and disincentives must be removed to take full advantage
5. Current training does not equip DOD personnel to understand the commercial marketplace

Commercial Trends Make ICMM Increasingly Desirable in 2010 and Beyond

***With improved insight into the comm'l base,
DoD can take advantage of:***

- **Commercial product technology trends**
 - Wireless comms, photonics, night vision, biomedical technology, fuel cells, microprocessors, MEMS
- **Commercial process technology trends**
 - Advances in automated design, production, and testing beyond the chip and board level
 - CAD/CAM interchange in supply chains
- **Contract Manufacturing**
 - New \$70B industry sector -- Electronics Mfg Services (EMS)
 - Flexible facilities suited to small lot custom mfg for defense

Long Standing Barriers Must Be Removed

~~*Recent policy changes will help — need implementation*~~

- **Acquisition rules unacceptable to commercial suppliers**
 - Accounting, auditing, specialized specs, procurement laws and socioeconomic provisions, logistics practices
- **Commercial item procurement (FAR Part 12) not aggressively implemented, not applicable to R&D**
- **Intellectual property rights rules incompatible with commercial practice**
- **Requirements, acquisition and upgrade cycle times drastically misaligned with commercial cycles**
- **Profit policies that discourage commercial outsourcing**
- **Savings not shared**

Current Training Does Not Equip DoD Personnel to Understand Commercial Marketplace

- **Individual PMs do not have time to pioneer ICMC without a supporting acquisition establishment**
 - A knowledge base and an acquisition workforce steeped in commercial practice -- program management staff, contracting officers, oversight personnel
- **Current training infrastructure is geared toward excellence in defense acquisition**
 - Little emphasis on commercial capabilities and practices
- **Opportunity exists for leverage of existing resources**
 - DAU, DSMC, ICAF
 - Private sector training and exchange programs

Recommendations

- **Incentivize and institutionalize ICMM**
 1. Vigorously implement policy, incentives and guidelines for ICMM
 2. Contract for life-cycle support and technology refreshment, especially for electronics
- **Enable change**
 3. Establish the *Commercial Acquisition Academy* within DAU to Augment Training and Education
 4. Fund and execute rapid-response demonstration programs to build a broad ICMM experience base
 5. Create mechanisms to increase awareness of future commercial technology and capabilities
 6. Invest in R&D to increase the mutual compatibility of military operating environments and commercially produced components

ICMM Implementation

- **Impetus for change needs to come from the top**
 - USD(AT&L), SAEs and their staffs
 - Accountability at PEO level
- **Implementation needs to occur at PM and Contracting Officer level**
 - Training is key -- establish Comm'l Acq Academy
- **Experiments and rapid response demos should be encouraged**
 - Direct and fund ManTech to facilitate

Role of ManTech

- **ManTech has unique statutory mandate**
 - If funded, can aggressively pursue ICMM demos
- **Examples of recommended role:**
 - Acquisition war games and case studies for ICMM (w/ DAU)
 - Demos with PEOs/PMs to explore and validate optimum use of commercial base (emphasis on “how to”)
 - Tools and methods to model relationships between design, commercial producibility, and life cycle supportability
 - Methods to achieve six-sigma quality on defense and commercial co-manufacturing lines
 - Technologies and practices for lot-size-one manufacturing
 - Technologies for using commercial parts and subsystems in military operating environments

There is a Downside

But It's Manageable

- **Rapid obsolescence of commercial technology**
 - Mitigated by contractor support and upgrade responsibility
- **Quality and reliability of commercial parts**
 - DoD and primes need to be smart buyers
- **Loss of workload for primes**
 - Shared savings and win-win contract provisions
- **Risk of unauthorized design features in globally sourced components**
 - May need to avoid in highly sensitive applications

Conclusion

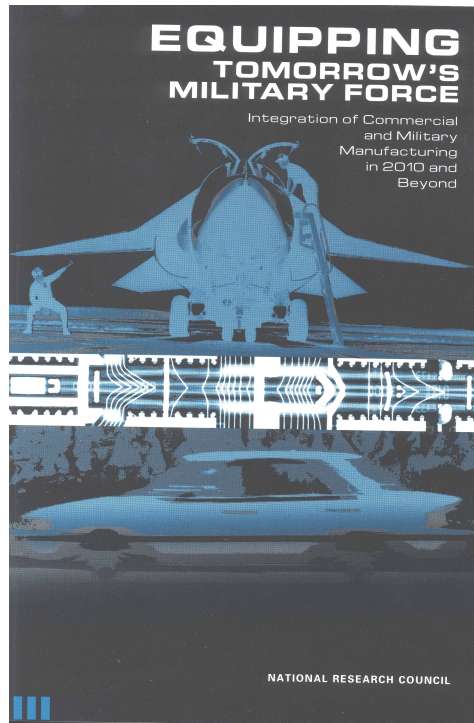
- **ICMM has same objective as the rest of the Defense strategy for 2010 and beyond**
 - Fast response to unpredictable needs
- **Benefits are large, implementation costs are low**

***Make ICMM part of DoD's transformation,
with top level backing and implementation
urgency***

***on a par with other transformation
objectives***

Equipping Tomorrow's Military Force

Integration of Commercial and Military Manufacturing in 2010 and Beyond



Report available from
National Academy Press
www.nap.edu

Backup

Findings and Recommendations

Sponsor's Task Statement

From the Chair of the DOD JDMTP

Assess opportunities for increased integration of commercial and military manufacturing in 2010 and beyond.

1. Identify advances in commercial technology and “best practices”
2. Identify areas where rapid commercial advances could be leveraged
3. Identify weapon systems suitable for commercial production
4. Identify barriers and methods for overcoming these barriers
5. Recommend strategies for optimizing the integration of commercial and military manufacturing in the next decade, including ManTech role.

***“Big M” definition of manufacturing
is implicit***

Defense System Integrators Have the Pivotal Role in ICMM

- **System integration of superior technologies is the edge**
 - Commercial production beneficial only if defense primes tap into it
 - **ICMM offers DoD benefits**
 - Continue a competitive defense industrial base, while reducing investment in defense-specific facilities
 - **ICMM offers Defense Primes benefits**
 - Same rewards and business potentials as commercial OEMs
- But only if barriers and disincentives are removed***

Recent Successes in ICMM Show It Can Be Done

- **Numerous experiments and pilot programs**
 - Avionics, aircraft engines, submarine electronics, trucks
 - All required extraordinary contracting actions
 - Take too long, results not well institutionalized
- **Benefits are anecdotal but promising**
 - Savings of over 50% in time and unit cost compared to traditional defense manufacturing
 - Meeting performance and operating environment needs
- **Design for commercial manufacture is key (IPPD)**
- **Defense contractors and commercial suppliers are willing to engage when incentives are right**

Commercial Trends Make ICMM Increasingly Desirable in 2010 and Beyond

***With improved insight into the comm'l base,
DoD can take advantage of:***

- **Commercial product technology trends**
 - Wireless comms, photonics, night vision, biomedical technology, fuel cells, microprocessors, MEMS
- **Commercial process technology trends**
 - Advances in automated design, production, and testing beyond the chip and board level
 - CAD/CAM interchange in supply chains
- **Contract Manufacturing**
 - New \$70B industry sector -- Electronics Mfg Services (EMS)
 - Flexible facilities suited to small lot custom mfg for defense

Long Standing Barriers Must Be Removed

~~*Recent policy changes will help — need implementation*~~

- **Acquisition rules unacceptable to commercial suppliers**
 - Accounting, auditing, specialized specs, procurement laws and socioeconomic provisions, logistics practices
- **Commercial item procurement (FAR Part 12) not aggressively implemented, not applicable to R&D**
- **Intellectual property rights rules incompatible with commercial practice**
- **Requirements, acquisition and upgrade cycle times drastically misaligned with commercial cycles**
- **Profit policies that discourage commercial outsourcing**
- **Savings not shared**

Current Training Does Not Equip DoD Personnel to Understand Commercial Marketplace

- **Individual PMs do not have time to pioneer ICMC without a supporting acquisition establishment**
 - A knowledge base and an acquisition workforce steeped in commercial practice -- program management staff, contracting officers, oversight personnel
- **Current training infrastructure is geared toward excellence in defense acquisition**
 - Little emphasis on commercial capabilities and practices
- **Opportunity exists for leverage of existing resources**
 - DAU, DSMC, ICAF
 - Private sector training and exchange programs

Recommendations

- **Incentivize and institutionalize ICMM**
 1. Vigorously implement policy, incentives and guidelines for ICMM
 2. Contract for life-cycle support and technology refreshment, especially for electronics
- **Enable change**
 3. Establish the *Commercial Acquisition Academy* to Augment Training and Education
 4. Fund and execute rapid-response demonstration programs to build a broad ICMM experience base
 5. Create mechanisms to increase awareness of future commercial technology and capabilities
 6. Invest in R&D to increase the mutual compatibility of military operating environments and commercially produced components

Vigorously Implement Policy, Incentives and Guidelines for ICMM

- **USD (AT&L) should issue implementing guidelines**
 - Remove barriers, provide metrics, monitor in milestone reviews.
- **Implementing guidelines should address:**
 - Competitive source selection factors
 - Profit policies to make ICMM a profitable and viable business decision.
 - Sharing of any savings attributable to ICMM.
 - Use of "Other Transactions" until legislation is available to enable commercial intellectual property rights practices
 - Flexibility to determine that products or services are commercial items under FAR Part 12, and demonstration programs for the challenge of pricing commercial items.
 - Metrics, such as commercial content based on bills of material
 - Use of commercial design standards and participation in standards setting bodies.
 - Use of the DOD Acquisition Research Program to develop additional tools to facilitate buying from the commercial sector.

Contract for Life-Cycle Support / Technology Refreshment

- **Give total product responsibility to the system integrator for design, production, product support, and system availability**
 - Include responsibility for commercially based technology refreshment, especially for electronics
- **USD(AT&L) should issue implementing guidelines to:**
 - Use only performance specifications
 - Give configuration management authority to the contractor, with DOD retaining form, fit, and function interchangeability.
 - Provide incentives for technology refreshment. Minimize costs and time for requalification except where necessary for safety.
 - Use interface control documents and functional specifications to manage the contractor.
 - Use multiple-year production pricing curves that incentivize the design and production of reliable systems in a cost-effective manner.
 - Demonstrate and encourage lean sustainment and just-in-time supply-chain practices.

Establish the *Commercial Acquisition Academy* to Augment Training and Education

- **Establish the *Commercial Acquisition Academy* within the DAU to create an acquisition workforce steeped in commercial practice**
 - PMs, contracting officers, other acquisition personnel
- **Important attributes:**
 - Commercial best practices through case studies and practical exercises
 - Use of industry associations and business schools in curriculum development and in augmenting the regular faculty.
 - A faculty with skills in commercial industry practices
 - Specific training in overcoming barriers that preclude commercial firms from doing business with DOD, using existing legal and regulatory latitude
 - Experience with industry, including cross-training initiatives between government and industry.
 - Benchmarking current commercial practices and using commercial terminology throughout the Academy's programs.

Recommendation 4

Fund and Execute Rapid-response Demonstration Programs

- **Foster demonstration programs to build the base of experience needed for increased ICMM.**
 - Advocate, plan, program, budget and protect the necessary resources for these demonstrations
 - Provide waivers, as needed, to experiment with commercial practices.
 - Examine the potential for the Defense Production Act Titles I and III (including the Diminishing Manufacturing Sources and Industrial Base Analysis programs) to support a robust transformation to an ICMM base.
 - Focus and fund the DOD ManTech Program to initiate, execute and transition significant ICMM demonstration projects

Increase Awareness of Future Commercial Technology and Capabilities

- **The USD(A&T)/SAEs should develop programs to increase DOD and defense contractor insight into emerging commercial products and planned technologies**
 - Use in defining requirements for acquisition and upgrade programs.
- **These new insight programs should include:**
 - Designating and training DOD personnel who will specialize in commercial market research and advising the acquisition community on emerging commercial products and production capabilities
 - Supplementing this in-house capability with access to commercial market research companies and their knowledge bases.
 - Encouraging defense primes to establish business relationships that give them insight into the proprietary plans of commercial partners

R&D for Compatibility of Military Operating Environments and Commercially Produced Components

- **DDR&E should establish a program to mitigate the effects of differences between military operating environments and commercial operating environments**
 - Harden commercial items to perform reliably in military environments (temperature, humidity, shock, vibration, and radiation)
 - Weapons system features that isolate or buffer commercial components from such environments
 - Funding for R&D programs to develop the needed solutions
- **Mission could be assigned to the DOD ManTech program**